

A New Technique for Performing *In Vivo* Efficiency Calibration Measurements
Suitable for Chestwall Thicknesses in Excess of 4 cm.

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Direct, *in vivo* measurement of activity in the lungs is very dependent upon the amount and type of tissue present in the chestwall. Calibration measurements require use of tissue substitutes of increasing thickness to simulate the change in efficiency as the human chestwall increases in size. The Livermore thoracic phantom, the *defacto* calibration standard for *in vivo* lung measurements, features a base chest plate with an integral skeleton plus overlay plates to accommodate a limited range of chestwall thicknesses and tissue types. The phantom was originally designed for use with large detectors, typically 12,700 mm². Many whole body counters in the U. S. now use arrays of 4 – 6 smaller detectors, typically 2,000-3,500mm² each.

This research is investigating whether the reported exponential average thicknesses for the base and each overlay plate are appropriate for arrays using smaller detectors. The actual measured thickness of the base plate and each overlay plate at positions under each individual detector in the array has been compared with previously reported values and found to differ, especially for the base plate. Differences in thickness for the base plate can be partially attributed to the imbedded skeleton, which makes the interior surface very irregular.

An alternative to the large, bulky overlay plates for the Livermore phantom has been designed that is more convenient to use, easier to store, and can be made in a thickness that is especially suitable for larger subjects. This new design involves a set of individual detector endcap covers that are formulated using polyurethane-based materials to simulate human muscle and adipose tissue. The covers fit snugly over each detector endcap and are easily made to simulate a tissue thickness that is appropriate for the chestwall of larger subjects. The latter is important because it is not unusual to encounter chestwall thicknesses greater than approximately 4 cm, the maximum thickness available using the Livermore torso phantom. An efficiency calibration for ²⁴¹Am in the lungs using the new detector endcap covers was comparable to the conventional calibration and demonstrates that efficiency measurements can be performed to accommodate subjects having very thick chestwalls.